CLAIMS:

1. A method of imaging a region of interest, comprising:

acquiring images through said region of interest;

introducing varying levels of inspiratory contrast agents to said region of interest, said inspiratory contrast agents stimulating vascular changes in said region of interest; and

obtaining optical measurements on oxy- and deoxy-hemoglobin of said region of interest during said introducing step, thereby acquiring differential vascular function information useful in detecting cancerous tumors.

2. The method according to claim 1, further comprising the step of:

positioning said region of interest between a light source and a camera.

3. The method according to claim 1, further comprising the step of:

immersing said region of interest in a matching medium.

4. The method according to claim 1, further comprising the step of:

maintaining said matching medium at 37°C.

5. The method according to claim 1, further comprising the step of:

mildly compressing said region of interest.

6. The method according to claim 1, wherein

said inspiratory contrast agents are oxygen and carbon dioxide.

7. The method according to claim 1, wherein said region of interest is a breast of a human subject.

8. The method according to claim 5, further comprising the step of:

administering, by inhalation, said human subject with a gas mixture composed of air and said inspiratory contrast agents, wherein said inspiratory contrast agents are oxygen and carbon dioxide.

9. The method according to claim 1, further comprising the step of:

automatically controlling said varying levels with one or more flow controllers.

10. A system configured to implement the method steps of claim 1.

11. A noninvasive method of detecting cancerous tumors *in vivo*, comprising the steps of:

utilizing differential vasoactive optical imaging to acquire images through a region of interest before and during inhalation of varying levels of vasoactive agents; wherein

said vasoactive agents are oxygen and carbon dioxide; and wherein

said vasoactive agents stimulate vascular changes in said region of interest, resulting dramatically increase in contrast between cancerous and noncancerous tissue in said region of interest.

12. The method according to claim 11, wherein said region of interest is an optically accessible area of a human body.

13. The method according to claim 11, wherein said region of interest is a human breast.

14. An imaging system comprising:

a means for administering varying levels of vasoactive agents to a human or animal subject having a region of interest;

a near infrared light source directed at said region of interest;

an image acquisition means for acquiring images of said region of interest before and during administration of said vasoactive agents; and

a processing means for analyzing said images to identify vasculature associated with angiogenic vasculature in cancerous tumors.

15. The imaging system of claim 14, wherein
said vasoactive agents are oxygen and carbon dioxide.

16. The imaging system of claim 14, wherein
said image acquisition means is a charge-coupled device camera that is sensitive in near infrared.

17. The imaging system of claim 14, wherein
said near infrared light source is an array of light emitting diodes capable of operating at a plurality of wavelengths including 780 nm, 840 nm and 970 nm.

18. The imaging system of claim 14, further comprising:
an immersion medium immersing said region of interest; and
a holding means containing said immersion medium.

19. The imaging system of claim 18, wherein
said immersion medium is a tissue phantom liquid having optical properties substantially matching those of said region of interest.

20. The imaging system of claim 18, wherein
said holding means is a doughnut-shaped transparent bag filed to a slight overpressure to press against said region of interest.

21. The imaging system of claim 14, further comprising:
one or more flow controllers for controlling levels of said vasoactive agents being administered to said subject.

22. The imaging system of claim 21, wherein
said flow controllers are capable of rapidly alternating among different gas compositions containing said vasoactive agents while continuously varying levels of said vasoactive agents.